TITLE: The 2,5D Electromagnetic Analysis in Time Domain Mode

THE 2,5D ELECTROMAGNETIC ANALYSIS IN TIME DOMAIN MODE

Timothey V. Kamichev, Constantin N. Klimov,
Boris V. Sestroretsky* and Sergey A. Ivanov*

Moscow State Institute of Electronics and Mathematics, Bolshoy Trechsvytitelsky lane 3/12, Moscow 109028, Russia, ph. (095)-916-88-17, E-mail: const0@online.ru

* Lavochkin Association, Leningradskay st. 24, Chimki-2 Moscow Area 141400, Russia, ph. (095)-575-50-69, E-mail: const0@online.ru

ABSTRACT

The expressions are submitted, allowing to make transformation E-plane waveguide the tasks containing 5 component of an electromagnetic field (for example H_x, H_y, H_z, E_y, E_z), to the scalar 2D task containing to 3 unequal zero components of an electromagnetic field (H_x, E_y, E_z). At such transformation the magnitude appropriate to magnetic permeability it becomes frequency dependent. It corresponds to dielectric permeability of plasma, if plasma frequency corresponds to cutoff frequency of a wave H_{m0}. This fact has allowed to use for the analysis in time domain E plane waveguide facility earlier developed effective programs 2D the electromagnetic analysis. The example of the analysis in time domain of the filter constructed on the basis of a rectangular waveguide with variations of the geometrical sizes in E plane is given.

INTRODUCTION

In engineering practice are frequently used E-plane waveguide devices . For the electrodynamics analysis of such devices in frequency domain were developed effective procedures [1-3]. Now all greater attention is given investigations directly in time domain: tasks of a location supershort impulse and signals with a wide spectrum. In view there was a task of development of the technique used usually in frequency domain to have an opportunity to investigate characteristics of devices directly in time domain. The historical moment is interesting also. During absence of computing device for analog modeling plasma were used waveguide devices, and in the present work it is offered for the analysis in time domain waveguide devices to use the developed effective programs for the analysis of non-uniform plasma.

STATEMENT E-PLANE PROBLEM IN THE RECTANGULAR WAVEGUIDE

Let's consider the structure were the E-plane device on the basis of a rectangular waveguide with metal walls, which is represented on fig. 1. Inputs of the device are rectangular waveguides, which are raised by a wave H_{m0}.

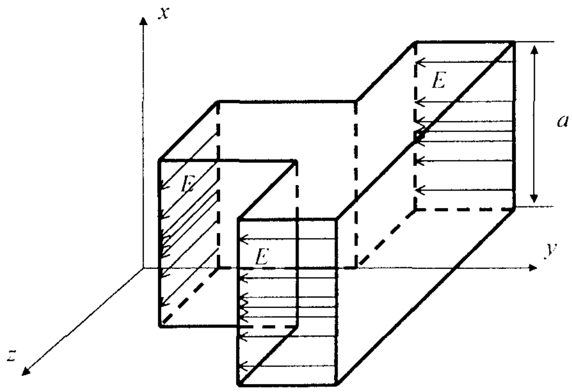

Fig. 1. Geometry E - plane device on the basis of a rectangular waveguide.

Devices of such type refer to E-plane, as all changes of geometry occur only in a plane of a vector of intensity of electric field E (plane ZOY see Fig. 1.), and the width of the device remains to a constant and is equal a. From the mentioned above conditions follows, that should the following ratio will be executed [4]:

$$E_x = 0 \tag{1}$$

$$E_y(x,y,z) = \sin\frac{m\pi x}{a} E_y(y,z) \tag{2}$$

$$E_z(x,y,z) = \sin\frac{m\pi x}{a} E_z(y,z) \tag{3}$$

$$H_x(x,y,z) = \sin\frac{m\pi x}{a} H_x(y,z) \tag{4}$$

For the decision of a problem it is necessary to write down Maxwell's equations a in the chosen Cartesian system of coordinates (see fig. 1) and to substitute in the received system of the equations of a condition (1) - (4) in view of that foreign electric and magnetic currents inside analyzed area are equal to zero

By virtue of that ratio should will be executed at any values x, we receive the equations, not dependent on it. Analyzing these equations, we shall find final system of the differential equations which after use of properties of a permutable duality [4], can be written down in the following kind:

$$\frac{\partial E_x(y,z)}{\partial z} = i\omega\mu_a H_y(y,z) \tag{5}$$

$$-\frac{\partial E_x(y,z)}{\partial y} = i\omega\mu_a H_z(y,z) \tag{6}$$

$$\frac{\partial H_z(y,z)}{\partial y} - \frac{\partial H_y(y,z)}{\partial z} = -i\omega\varepsilon_a(\omega)E_x(y,z) \tag{7}$$

The fact of concurrence frequency dependences permittivity is interesting in case of plasma and at the decision waveguide tasks that allows to investigate directly in time domain mode non-stationary processes for E Plane waveguide devices, using effective algorithms and the programs developed for the decision of bidimentional problems of

dispersion from non-uniform plasma formations in time domain mode on the basis of a method of impedance analogue of electromagnetic space [6]. As an example of similar research we shall result analysis *E* plane rejector the filter.

RESEARCH E PLANE REJECTOR THE FILTER

As an example we shall investigate characteristics E plane rejector the filter submitted on (fig. 2.)

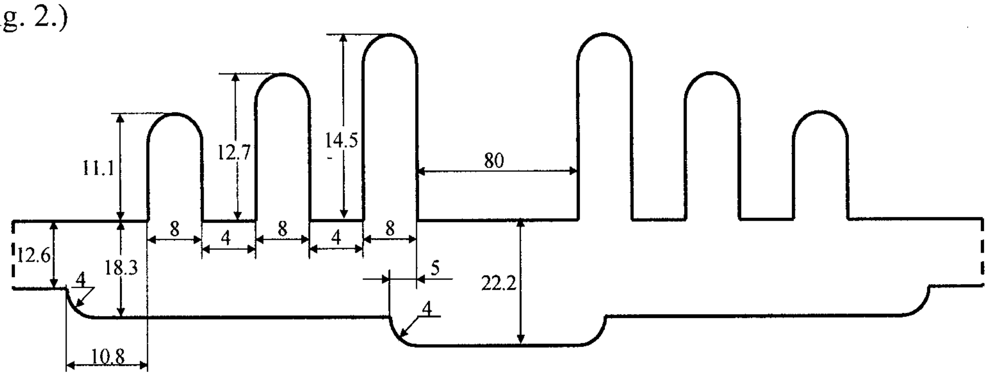

Fig. 2. Geometry E plane device on the basis of a rectangular waveguide.

All sizes of topology designed waveguide the filter, width *28.5mm*, represented on (fig. 2.) in a plane of a vector E, specified in millimeters. On (fig. 3 and 4) time dependences of amplitudes reflected (it is designated square) and past (it is designated cross) waves suppressed frequency band on frequency f=7.170 GHz and in a passband on frequency f=8.425 GHz are shown.

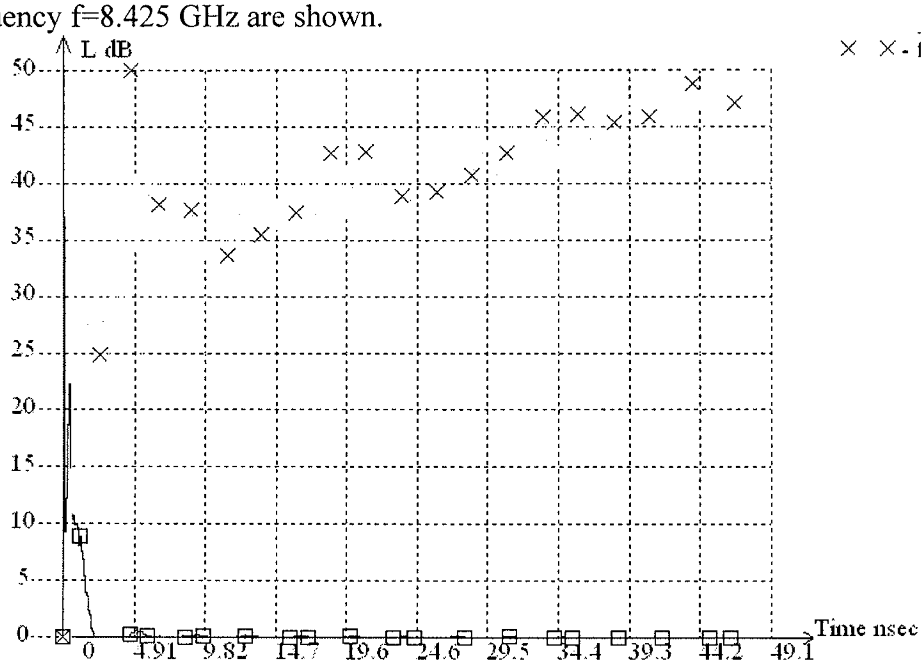

Fig. 3. Dependence on time of amplitude of the reflected and past wave at inclusion of a sinusoid with frequency of filling 7.170 GHz.

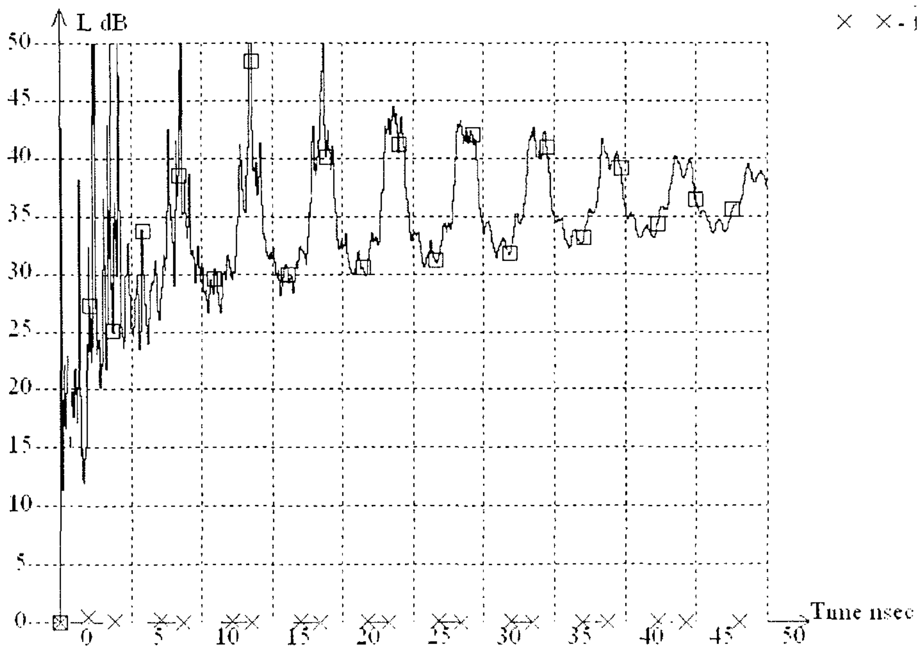

Fig. 4. Dependence on time of amplitude of the reflected and past wave at inclusion of a sinusoid with frequency of filling 8.425 GHz.

In the present work the expressions which are carrying out transformation E-plane waveguide of problems to a scalar 2D problem with permeability, having frequency dispersion that has allowed to use for the analysis in time domain mode E plane waveguide devices earlier developed effective programs 2D the electromagnetic analysis are given.

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